

WHAT IS CLAIMED IS:

1. A metrology tool for aligning a robot having an engagement member for engaging a semiconductor substrate carrier disposed on a tool load-port, comprising:
- 5 a frame having an opening; and
- a removable alignment gauge member slidably received in said frame opening, said alignment gauge member having an opening to receive said robot engagement member when inserted in said frame opening.
- 10 2. The tool of claim 1 wherein said alignment gauge member has a front face positioned to be engaged by said robot engagement member when said robot engagement member is misaligned with respect to said alignment gauge member opening, said alignment gauge member being adapted to slide
- 15 when said alignment gauge member front face is engaged by said robot engagement member.
3. The tool of claim 1 wherein said robot engagement member is a registration pin and said alignment gauge member opening is sized and shaped
- 20 to receive said registration pin when said alignment gauge member opening is aligned with respect to said registration pin.
4. The tool of claim 3 wherein said alignment gauge member opening is cylindrically shaped.
- 25 5. The tool of claim 1 wherein said frame opening is cylindrically shaped and said removable alignment gauge member has a cylindrically shaped portion adapted to be slidably received by said frame opening.

6. The tool of claim 1 wherein said robot engagement member is a door key and said alignment gauge member opening is sized and shaped to receive said door key when said alignment gauge member opening is aligned with respect to said door key.

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7. The tool of claim 6 wherein said alignment gauge member opening is rectangularly shaped.

8. The tool of claim 6 wherein said frame opening is cylindrically shaped and said removable alignment gauge member has a cylindrically shaped portion adapted to be slidably received by said frame opening, said frame further having one of an alignment pin and an alignment pin hole and said alignment gauge member having the other of said alignment pin and an alignment pin hole wherein said alignment hole is positioned to align said alignment gauge member to said frame when said alignment pin is received in said alignment hole.

9. The tool of claim 1 further comprising a plurality of removable alignment and support receptacles fastened to said frame and positioned to support said frame on said tool load-port.

10. The tool of claim 9 wherein each of said receptacles has four alignment surfaces and said frame has four alignment surfaces for each receptacle, each frame alignment surface being positioned to be engaged by an associated receptacle alignment surface to align the frame and associated receptacle when fastened to the frame.

11. The tool of claim 10 wherein each receptacle has a block-shaped portion which provides said four receptacle alignment surfaces, and wherein

said frame has an aperture for each receptacles wherein each frame aperture defines said four frame alignment surfaces which are positioned to receive and align an associated receptacle portion.

- 5           12.    The tool of claim 11 further comprising a plurality of removable fasteners for fastening each removable receptacle to said frame when said receptacle block-shaped portion is received in said frame aperture.
- 10           13.    The tool of claim 1 wherein said frame includes a base plate, a frame plate carried by said base plate, and a removable door plate releasably fastened to said frame plate wherein said door plate defines said frame opening.
- 15           14.    The tool of claim 13 wherein said frame further includes a plurality of alignment pins adapted to align said door plate to said frame plate when said door plate is fastened to said frame plate.
- 20           15.    The tool of claim 1 wherein said frame opening defines a central axis and said alignment gauge member opening defines a central axis offset with respect to said frame opening central axis, said alignment gauge member being adapted for rotation in said frame opening about said frame opening axis.
- 25           16.    The tool of claim 15 wherein said alignment gauge member has a first indicia and said frame has a second indicia adjacent said frame opening, said first and second indicia being adapted to provide an indication of the rotational position of said alignment gauge member within said frame opening.
17.    The tool of claim 16 wherein at least one of said indicia include

angular position indicia expressed in degrees.

18. A metrology tool for aligning a door-opening robot having a pair of registration pins and a pair of latch keys for engaging a pair of registration  
pin holes and a pair of latch key holes, respectively of a plastic door of a  
5 plastic Front-Opening Universal Pod (FOUP) having three plastic receptacles,  
each receptacle adapted to be disposed on an alignment and support coupling  
pin of a tool load-port of a factory interface, said metrology tool comprising:
- a metal frame having a metal base plate having three metal  
10 receptacles, each receptacle configured and positioned to emulate one of said  
FOUP receptacles, said frame further having a metal front plate carried by  
said base plate, and a pair of metal side brace members, each adapted to  
brace said front plate with respect to said base plate, said front plate defining  
at least four cylindrical openings;
- 15 first and second cylindrical metal removable registration pin  
alignment members, each registration pin alignment member being slidably  
received in a front plate opening and having a cylindrical opening sized and  
shaped to emulate a FOUP registration pin hole and to receive a robot  
registration pin when said registration pin alignment member opening is aligned  
20 with respect to a robot registration pin, each registration pin alignment member  
further having a front face positioned to be engaged by a robot registration pin  
when a robot registration pin is misaligned with respect to the associated  
registration pin alignment member opening, said registration pin alignment  
member being adapted to slide when said registration pin alignment member  
25 front face is engaged by a robot registration pin; and
- first and second cylindrical metal removable latch key alignment  
members, each latch key alignment member being slidably received in a front  
plate opening and having a rectangular opening sized and shaped to emulate a  
FOUP latch key hole and to receive a robot latch key when said latch key

- alignment member opening is aligned with respect to a robot latch key, each latch key alignment member further having a front face positioned to be engaged by a robot latch key when a robot latch key is misaligned with respect to the associated latch key alignment member opening, said latch key
- 5 alignment member being adapted to slide when said latch key alignment member front face is engaged by a robot latch key.

19. A metrology tool kit for aligning a robot having an engagement member for engaging a semiconductor substrate carrier disposed on a load
- 10 port tool, comprising
- a frame having an opening; and
  - a plurality of removable alignment gauge members, each alignment gauge member being adapted to be selectably inserted and removed from said frame opening one at a time, each member having an
- 15 opening to receive said robot engagement member when inserted in said frame opening wherein said member openings differ in size.

20. The tool kit of claim 19 wherein a first alignment gauge member of said plurality has a member opening of a first size and a second alignment
- 20 gauge member of said plurality has a member opening of a size approximately 100.2% of said first size.

21. The tool kit of claim 19 wherein a first alignment gauge member of said plurality has a member opening of a first size and a second alignment
- 25 gauge member of said plurality has a member opening of a size approximately 104% of said first size.

22. The tool kit of claim 19 wherein a first alignment gauge member of said plurality has a member opening of a first size and a second alignment gauge member of said plurality has a member opening of a size approximately

108% of said first size.

23. A metrology tool for aligning a robot having a pair of registration  
5 pins and a pair of latch keys for engaging a door of a substrate carrier  
disposed on a tool load-port, comprising:  
a frame adapted to be disposed in said tool-load port and having at  
least four openings;  
first and second removable registration pin alignment members, each  
10 registration pin alignment member being slidably received in a frame opening  
and having an opening sized and shaped to receive a robot registration pin  
when said registration pin alignment member opening is aligned with respect to  
a robot registration pin, each registration pin alignment member further having  
a front face positioned to be engaged by a robot registration pin when a robot  
15 registration pin is misaligned with respect to the associated registration pin  
alignment member opening, said registration pin alignment member being  
adapted to slide when said registration pin alignment member front face is  
engaged by a robot registration pin; and  
first and second removable latch key alignment members, each  
20 latch key alignment member being slidably received in a frame opening and  
having an opening sized and shaped to receive a robot latch key when said  
latch key alignment member opening is aligned with respect to a robot latch  
key, each latch key alignment member further having a front face positioned to  
be engaged by a robot latch key when a robot latch key is misaligned with  
25 respect to the associated latch key alignment member opening, said latch key  
alignment member being adapted to slide when said latch key alignment  
member front face is engaged by a robot latch key.

24. A metrology tool for aligning a robot having a carrier door key for

unlatching a carrier door of a substrate carrier disposed on a tool load-port,  
comprising:

carrier frame emulation means for resting on said tool load-port and for  
emulating a substrate carrier frame; and

- 5 door emulation means carried by said carrier frame emulation means for  
emulating a door of said substrate carrier, said door emulation means having  
an opening and a removable alignment gauge means slidably carried in said  
door emulation means opening for gauging alignment of a robot door key, said  
alignment gauge means including opening means for emulating a door key  
10 opening, wherein said alignment gauge opening means receives said robot  
carrier door key when said alignment gauge opening means is carried in  
alignment with said robot carrier door key and wherein said alignment gauge  
means slides in response to being engaged by said robot door carrier door key  
when said alignment gauge means opening is carried in misalignment with said  
15 robot carrier door key.

25. A method of aligning a robot engagement member to a door  
opening of a carrier door of a substrate carrier disposed on a tool load-port,  
comprising:

- 20 disposing a frame emulating a carrier frame on said tool load-port;  
placing a first alignment gauge insert into an opening in said frame; and  
driving said robot engagement member toward said alignment gauge  
insert wherein an opening in said alignment gauge receives said robot  
engagement member when said alignment gauge opening is in alignment with  
25 said robot engagement member and wherein said alignment gauge insert  
slides in response to being engaged by said robot engagement member when  
said alignment gauge opening is misaligned with said robot engagement  
member.

26. The method of claim 25 wherein said robot engagement member is a registration pin and said alignment gauge member opening is sized and shaped to receive said registration pin when said alignment gauge member opening is aligned with respect to said registration pin.

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27. The method of claim 26 wherein said robot engagement member is a door key and said alignment gauge member opening is sized and shaped to receive said door key when said alignment gauge member opening is aligned with respect to said door key.

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28. The method of claim 25 further comprising removing an alignment and support receptacle from said frame; fastening a substitute alignment and support receptacle to said frame; and positioning said frame substitute alignment and support receptacle on said tool load-port.

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29. The method of claim 28 further comprising engaging four alignment surfaces of said substitute receptacle with four alignment surfaces of said frame to align said substitute receptacle with said frame prior to fastening said substitute receptacle to said frame.

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30. The method of claim 29 wherein said substitute receptacle has a block-shaped portion which provides said four receptacle alignment surfaces, and wherein said frame has an aperture which defines said four frame alignment surfaces, said alignment surface engaging including positioning said block-shaped portion of said substitute receptacle in said frame alignment aperture.

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31. The method of claim 30 wherein said fastening comprises fastening removable fasteners fastening said substitute receptacle to said



frame when said receptacle block-shaped portion is received in said frame aperture.

32. The method of claim 25 wherein said frame includes a base  
5 plate, a frame plate carried by said base plate, and a removable door plate releasably fastened to said frame plate wherein said door plate defines said frame opening, the method further comprising removing said door plate from said frame plate and fastening a substitute door plate to said frame plate.

33. The method of claim 32 further comprising aligning said substitute  
10 door plate to said frame plate using alignment pins prior to fastening said substitute door plate to said frame plate.

34. The method of claim 25 further comprising removing said first  
15 alignment gauge insert from said frame and placing a substitute alignment gauge insert in said frame opening wherein said substitute alignment gauge opening has an opening which is smaller in size than said first alignment gauge insert opening, said method further comprising driving said robot engagement member toward said substitute alignment gauge insert wherein said opening in  
20 said substitute alignment gauge receives said robot engagement member when said substitute alignment gauge opening is in alignment with said robot engagement member and wherein said substitute alignment gauge insert slides in response to being engaged by said robot engagement member when said alignment gauge opening is misaligned with said robot engagement member.

35. The method of claim 34 wherein said first alignment gauge opening  
25 is 108% of the size of said substitute alignment gauge opening.

36. The method of claim 34 wherein said first alignment gauge opening  
is 104% of the size of said substitute alignment gauge opening.

37. The method of claim 34 wherein said first alignment gauge opening is 100.2% of the size of said substitute alignment gauge opening.

5 38. The method of claim 25 wherein said frame opening defines a central axis and said alignment gauge member opening defines a central axis offset with respect to said frame opening central axis, said alignment gauge member being adapted for rotation in said frame opening about said frame opening axis, said method further comprising rotating said alignment gauge  
10 member in a first rotational direction until said engagement member engages an internal surface of said alignment gauge member opening.

39. The method of claim 38 wherein said alignment gauge member has a first indicia and said frame has a second indicia adjacent said frame  
15 opening and adapted to provide an indication of the rotational position of said first indicia of said alignment gauge member within said frame opening, said method further comprising noting the indicated rotational position when said engagement member engages an internal surface of said alignment gauge member opening.

20 40. The method further comprising rotating said alignment gauge member in a second rotational direction opposite that of said first rotational direction until said engagement member engages an internal surface of said alignment gauge member opening and noting the indicated rotational position  
25 when said engagement member engages an internal surface of said alignment gauge member opening.

41. A method of aligning a robot registration pin and a robot latch key to a carrier door of a semiconductor substrate carrier disposed on a tool

load-port, comprising:

disposing a frame emulating a carrier frame on said tool load-port;

placing a registration pin alignment gauge insert into an opening in said frame, wherein said registration pin alignment gauge insert has an opening  
5 sized and shaped to receive said robot registration pin when registration pin alignment gauge insert opening is aligned with respect to said robot registration pin;

driving said robot registration pin toward said registration pin alignment gauge insert wherein said registration pin alignment gauge opening receives  
10 said robot registration pin when said registration pin alignment gauge insert opening is in alignment with said robot registration pin and wherein said registration pin alignment gauge insert slides in response to being engaged by said robot registration pin when said registration pin alignment gauge insert opening is misaligned with said robot engagement member;

15 placing a latch key alignment gauge insert into an opening in said frame, wherein said latch key alignment gauge insert has an opening sized and shaped to receive said robot latch key when said latch key alignment gauge insert opening is aligned with respect to said robot latch key.; and

driving said robot latch key toward said latch key alignment gauge  
20 insert wherein said latch key alignment gauge insert opening receives said robot latch key when said latch key alignment gauge insert opening is in alignment with said robot a latch key and wherein said latch key alignment gauge insert slides in response to being engaged by said robot latch key when said latch key alignment gauge opening is misaligned with said robot

25 engagement member.

42. A method of aligning a door-opening robot having a pair of registration pins and a pair of latch keys for engaging a pair of registration pin holes and a pair of latch key holes, respectively of a plastic door of a plastic

Front-Opening Universal Pod (FOUP) having three plastic receptacles, each receptacle adapted to be disposed on an alignment and support coupling pin of a tool load-port of a factory interface, comprising:

- disposing a metal frame having three metal receptacles on a plurality of  
5 alignment and support coupling pins of a tool load-port of a factory interface,  
each receptacle configured and positioned to emulate one of said FOUP  
receptacles on said tool load-port;

- placing a metal registration pin alignment gauge insert into an opening in  
said frame, wherein said registration pin alignment gauge insert has an  
10 opening sized and shaped to emulate a FOUP registration pin hole and to  
receive said robot registration pin when said registration pin alignment gauge  
insert opening is aligned with respect to said robot registration pin;

- driving said robot registration pin toward said registration pin alignment  
gauge insert wherein said registration pin alignment gauge opening receives  
15 said robot registration pin when said registration pin alignment gauge insert  
opening is in alignment with said robot registration pin and wherein said  
registration pin alignment gauge insert slides in response to being engaged by  
said robot registration pin when said registration pin alignment gauge insert  
opening is misaligned with said robot engagement member;

- 20 placing a metal latch key alignment gauge insert into an opening in said  
frame, wherein said latch key alignment gauge insert has an opening sized and  
shaped to emulate a FOUP latch key hole and to receive said robot latch key  
when said latch key alignment gauge insert opening is aligned with respect to  
said robot latch key; and

- 25 driving said robot latch key toward said latch key alignment gauge  
insert wherein said latch key alignment gauge insert opening receives said  
robot latch key when said latch key alignment gauge insert opening is in  
alignment with said robot a latch key and wherein said latch key alignment  
gauge insert slides in response to being engaged by said robot latch key when

said latch key alignment gauge opening is misaligned with said robot engagement member.

43. A metrology tool kit for aligning a robot having an engagement  
5 member for engaging a substrate carrier disposed on a load port tool,  
comprising
- a frame having an opening; and
- a plurality of removable alignment gauge members, each alignment  
gauge member being adapted to be selectably inserted and removed from said  
10 frame opening one at a time, each member having an opening to receive said  
robot engagement member when inserted in said frame opening wherein said  
member openings differ in size.

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